# CRAFTSMAN: A Framework for Flexible Robotic Tool Usage, Phase II Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

## ABSTRACT

TRACLabs has a long-term goal to provide a software toolkit for flexible tool use by robotic manipulators. Our proposed toolkit is a suite of state-of-the-art algorithms focused on extending current pick-and-place planning and control methods to enable robust tool usage by humanoid and other armed robots. Our system provide more intuitive tools for the user of the robotic manipulator, including visualization tools for defining tool use scenarios, including Cartesian tolerances along trajectories and expected forces/torques on the tool tip. This will allow robots to be more capable and more reliable during long-term autonomous tasks, by significantly improving the ability of remote supervisors to command complex tool-usage tasks, by enabling robots to operate safely alongside humans during shared tasks, and by providing a general tool usage framework that works with novel tools and with any robot configuration.

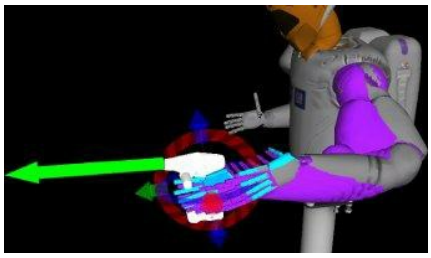
## ANTICIPATED BENEFITS

### To NASA funded missions:

Potential NASA Commercial Applications: NASA has several dexterous robots that assist humans in space activities. These include the R2 and Dextre robots on-board the International Space Station (ISS) and the Valkryie research robot being developed at NASA Johnson Space Center. These robots will need to use tools and interact with both remote supervisors and side-by-side human teammates. Our system provides software tools that increase the capabilities of dexterous robots and reduce the painstaking reliance on teleoperation. As more capable robots move beyond low-earth orbit, for example exploring the Moon or Mars, they will increasingly need sophisticated control algorithms focused on very dexterous manipulation and flexible reconfiguration in case of failure.

### To the commercial space industry:

Potential Non-NASA Commercial Applications: The Department of Defense (DoD) is investing heavily in very capable, dexterous



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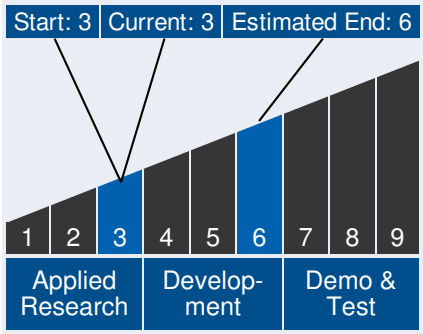


### Management Team

**Program Executives:**

- Joseph Grant
- Laguduva Kubendran

**Program Manager:**

- Carlos Torrez

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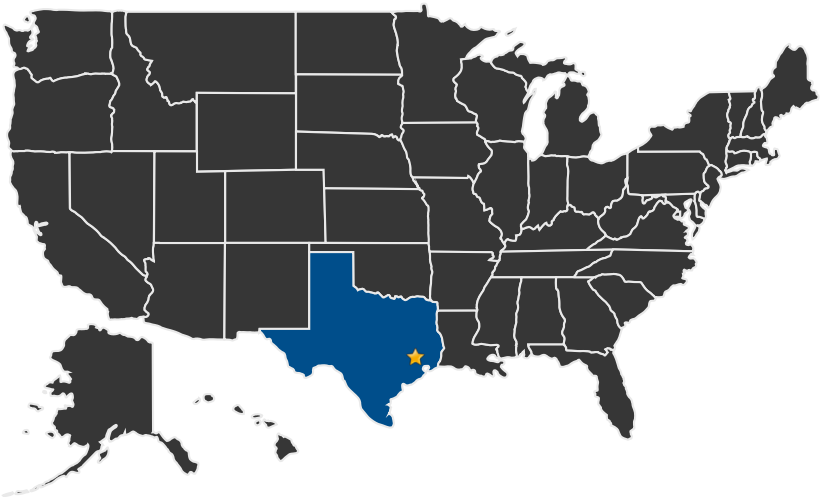
robots for tasks such as disaster relief, ordnance disposal, search and rescue, and casualty care and evacuation. These robots will need the sophisticated software produced in this project in order to perform their complicated tasks. Manufacturing robots are making new strides in dexterity and flexibility with robots such as Baxter and the GM R2. These robots will also need new control algorithms that allow them to manipulate tools and work alongside their human co-workers. The oil and gas industry is increasingly looking to automation to reduce worker injuries both on-shore and off-shore. Dexterous, mobile robots that can manipulation drilling rig tools and equipment will require software such as that produced by this project.

## U.S. WORK LOCATIONS AND KEY PARTNERS



U.S. States With Work

**Lead Center:**
Johnson Space Center

**Other Organizations Performing Work:**

- TRACLabs, Inc. (San Antonio, TX)

## Management Team *(cont.)*

**Principal Investigator:**

- Patrick Beeson

## Technology Areas

**Primary Technology Area:**
Robotics and Autonomous Systems (TA 4)
└ System-Level Autonomy (TA 4.5)
└ Activity Planning, Scheduling, and Execution (TA 4.5.2)
└ Onboard Real-Time Planning and Scheduling (TA 4.5.2.1)

**Secondary Technology Area:**
Robotics and Autonomous Systems (TA 4)
└ Human-System Interaction (TA 4.4)
└ Distributed Collaboration and Coordination (TA 4.4.5)

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## PROJECT LIBRARY

### Presentations

- Briefing Chart
  - (http://techport.nasa.gov:80/file/18070)

## DETAILS FOR TECHNOLOGY 1

### Technology Title

CRAFTSMAN: A Framework for Flexible Robotic Tool Usage